The Improvement of Cotton.

An Address before the New England Cotton Manufacturers' Association,

AT THEIR

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THE IMPROVEMENT OF COTTON.

The Department of Agriculture in its work on cotton is not trying to improve the machinery used in cotton manufacture or give you a new gin that will gin cotton cheaper or better. We are, however, as explained by the honorable Secretary of Agriculture, trying to produce for you better varieties than those now grown.

One of the principal methods used in the improvement of any plant is that of selection, which consists simply in taking seed for propagation from superior plants, selected because of their possessing in marked degree some important and valuable character, such as great yield, particularly fine or long staple, etc. Sea Island cotton, which is grown extensively on certain islands off South Carolina and Georgia, has been greatly improved by the very careful selection to which it has for years been subjected (Figure 1), until now it is recognized as the finest cotton produced anywhere in the world, the best grades selling at from 50 to 60 cents per pound. The method of selection which has been devised here and is in general use, is the most thorough and painstaking which the writer has ever seen used with any agricultural crop. Under this careful selection the standard of excellence of the staple has gradually increased, and this careful selection has become more and more necessary to keep the staple up to standard, until now one may truthfully say that the success of the industry has come to depend entirely upon the skill of the individual planter in selection. One of the illustrative cases which we will pass through the audience contains

samples of ordinary unselected Sea Island fibre in comparison with that of one of the finest selected strains (compare Figure 1). The selected strain is not only superior in length of staple, but in strength, silkiness, general quality, etc.

The factor of seed selection in cotton growing is of the greatest importance and yet I think it is safe to say that over 75 per cent. of the growers of upland cotton, and indeed many Sea Island cotton growers, pay no attention to it, simply taking their seed from the pile at a public gin, for instance, without any reference to the variety, vigor, productiveness, etc. It is entirely a matter of chance as to whether they get poor and worthless seed or seed of fair quality. Superior seed of any strain could never be obtained in this way other than as a rare accident. Where a factor of this kind is such an important one in the production of a paying crop, no grower can afford to leave it to chance. Growers should thus be instructed in the methods of selection and urged to give the matter careful attention, so that the strain grown may be increased in yielding capacity and the lint improved in quality.

In the improvement of cotton by selection, as the honorable secretary has explained to you, we do not aim solely to increase the length and quantity of the fiber, but many other important factors are taken into account. Resistance to disease is one important factor and it is in this direction, probably, that we may hope to obtain our most far-reaching and important results.

It has long been known that in many cultivated plants certain varieties are more resistant to disease than others. As an illustration we have varieties of oranges resistant to foot rot; grapes resistant to black rot and Phylloxera; wheats resistant to rusts, etc. Even with this knowledge, however, the intentional systematic breeding of resistant strains has only just begun and can only in the past few years be said to have taken shape as a definite method of controlling plant diseases.

For the last two years the department has had under investigation a disease of cotton known as "wilt", which has become very serious in certain sections where Sea Island cotton is

grown. The malady is caused by a parasitic fungus (*Neocosmospora vasinfecta*) which enters the small roots and grows up into the main stem, blackening the tissue and causing the leaves to wilt. The plants attacked are killed or stunted so that an entire crop may be a total loss, almost every plant succumbing to the disease.

This fungus unfortunately is not limiting itself to the Sea Islands and Sea Island cotton but is spreading in certain upland sections and bids fair to spread all over the cotton belt of the country and will certainly cause great destruction and loss unless a way of checking it is found. [Photographs were exhibited showing the great destruction caused in certain plantations of Sea Island and upland cotton.] The Division of Vegetable Physiology and Pathology of the Department has been conducting investigations of the disease and Mr. W. A. ORTON, who has had this phase of the work in charge, has grown experimental plats of a number of different cotton varieties on badly infected soil at Dillon, S. C. In the course of these experiments Mr. ORTON has found that certain varieties of cotton are almost wholly immune to the disease, not being seriously affected by it. The varieties of Egyptian cotton tested were all found to be resistant to a remarkable extent, the Jannovitch and Mit-Afifi, two of the best Egyptian sorts, being among the number tested. It was also found that the Jackson Limbless was much more resistant than other varieties of upland cottons, showing a remarkable difference in plats grown side by side. [Photographs were exhibited illustrating the comparative effect of the malady on immune and susceptible races.]

It early occurred to us that one of the best ways of combatting the disease was to select resistant strains, particularly of the fine Sea Island sorts, where no other kinds of the same quality could be obtained to take their places. In badly diseased fields where almost every plant is killed, frequently a plant here and there can be observed which stands up exceedingly vigorous. It was questionable whether these plants accidentally escaped infection or were actually immune. By carefully studying such plants,

however, Mr. ORTON found that they had been infected with the disease in many places, possibly hundreds of times, but were actually resistant and had grown on and overcome or thrown off the disease. Here then in these resistant plants we have the starting point for the production of resistant strains. By selecting seed for reproduction from these resistant plants we can doubtless in a few years breed up numerous strains sufficiently resistant to the disease to be practical for general culture. One test of the kind has already been made by Mr. ELIAS L. RIVERS* of James Island, S. C., a planter who has been co-operating with the Department in work on this disease. Mr. RIVERS last year collected seed from several resistant plants in a badly diseased field of Sea Island cotton and this year the seed was planted in a single row through a badly infested field, with ordinary Sea Island on each side. The row of cotton grown from this seed proved to be remarkably resistant, hardly a single plant showing any marked injury from the disease, while almost every plant of the ordinary Sea Island in adjoining rows were killed. [A photograph was exhibited showing this remarkable effect.] It should be remembered that this is the result of simply one year's selection, and a selection in which the immunity of the male parent was not considered. If, coupled with this selection of seed from resistant plants, the work had been started earlier in the season and flowers of resistant mother plants had been hand crossed with pollen from similar resistant plants, it is probable that a still greater and more lasting effect would have been obtained. This year the work is being done in a more careful, systematic way, and we are encouraged to believe that the disease may be entirely controlled in this manner.

Another line of cotton improvement work which is being investigated by the Department is the production of new and different varieties from those now existing. We are not satisfied to simply improve the strains that already exit, but desire to produce new ones. I am not certain whether it will meet your

*See paper on Sea Island Cotton by ELIAS RIVERS. Transactions New England Cotton Manufacturers' Association, Volume 59, page 244.

approval as manufacturers, but it seems to us that upland varieties producing a longer and better quality of staple would be very valuable and desirable. We hope to accomplish this by securing numerous hybrids of the best sorts of upland and Sea Island and then selecting from them the best individual plants. If the staple is to be increased in length to any great extent, it must be borne on a smooth black seed, like the Sea Island type, so that the fibre can be ginned on a roller gin. Mr. W. A. CLARK, of Columbia, S. C., who is co-operating with the Department of Agriculture in work of this kind, early realized the difficulties in the problem and took up the first necessary step — the production of a smooth-seeded strain of the upland cotton. This he secured after five or six generations of selection, in a race which he called the Klondike (Figure 2). This sort we have used many times in hybridization with Sea Island, etc.

In general the lint of the hybrids is about intermediate in length between the Sea Island and upland, and is of much better quality than the upland. Some of the hybrids are fairly productive, while others are nearly sterile. By a careful selection of seed from those which are of good quality and most productive, it would seem that we will certainly be able to produce an upland cotton that will give a longer staple than ordinary upland and yield abundantly in any upland cotton region. We already have several hybrids which, from tests this year, seem to be very promising. [Cases of samples of these hybrids were exhibited. Compare Figure 3.]

Another important feature of the hybrids is the large size of the bolls which in many cases are considerably larger than those of either parent (Figures 4 and 5). If this feature can be retained in a thoroughly fixed variety, it will be very important, as a large boll such as shown by the hybrids, which opens wide, is easy to pick and saves much time. When we consider the greater ease of picking and better staple produced by some of these hybrids it would seem that very great improvements may be obtained from them.

The Egyptian cottons also furnish an important field of ex-

periment in the line of breeding. The department, as explained by Mr. DEWEY this morning, has imported the best races of Egyptian cotton and is having them tested in various regions in the South. The quality of staple produced by these varieties in the United States is apparently as good as the imported staple, but the plants are usually unproductive and it will probably be necessary to improve the productiveness of the different races by selection before they will be satisfactory for growth here. We feel certain that sufficiently productive strains can be obtained by a comparatively few years of selection, and experiments in this direction are already under way. Some of the Egyption cotton is of a tawny brown color, a factor which is said to be of importance in the manufacture of some goods, and we find that these tawny varieties when grown in this country generally lose their color and become cream colored or white. In most cases, as for instance the Mit-Afifi or Ashmouni, occasionally a plant grown here will produce the normal tawny color. By selecting seed from these plants strains can doubtless be produced which will uniformly give the desired color.

If a deeper brown color is desired for any special purposes in manufacture, the Peruvian or Pieura cotton, which is very dark reddish-brown, can possibly be used in hybridization with our ordinary sorts to give the desired color. This, however, is a more hazardous line of experimentation and the results cannot be predicted.

In concluding these few remarks I desire to say that I should be very glad to have you ask any questions bearing on the subject in general, or criticise the features of improvement which we are trying to secure.

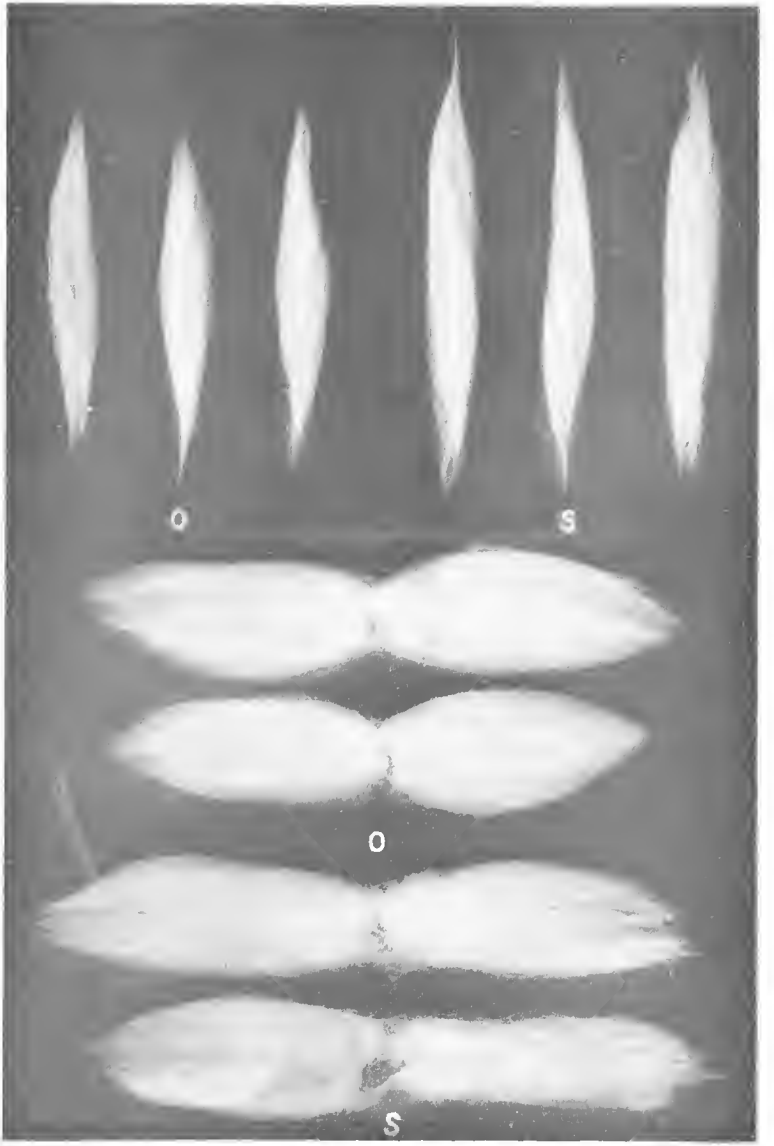

FIG. 1.

Improvement of Sea Island Cotton by selection: O, O, Ordinary Sea Island Cotton — Original Type from which selection was made; S, S, Selected Sea Island Cotton, showing increased length of Fibre. (7-8 natural size.)

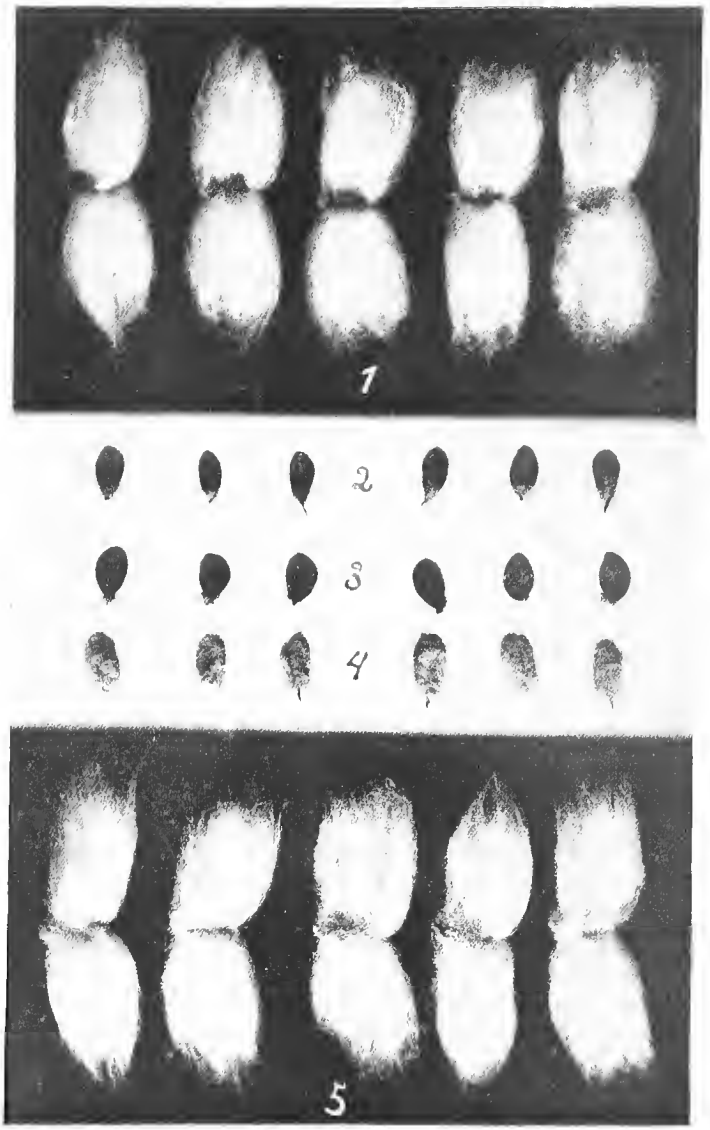

FIG. 2.

Seeds of Klondike, Sea Island, and Ordinary Upland Cotton: 1 and 2, Seeds of Klondike with and without lint; 3, Seeds of Sea Island Cotton 4 and 5, Tufted Seeds of Ordinary Upland Cotton (the variety from which the Klondike was developed), with and without lint. (13-16 natural size.)

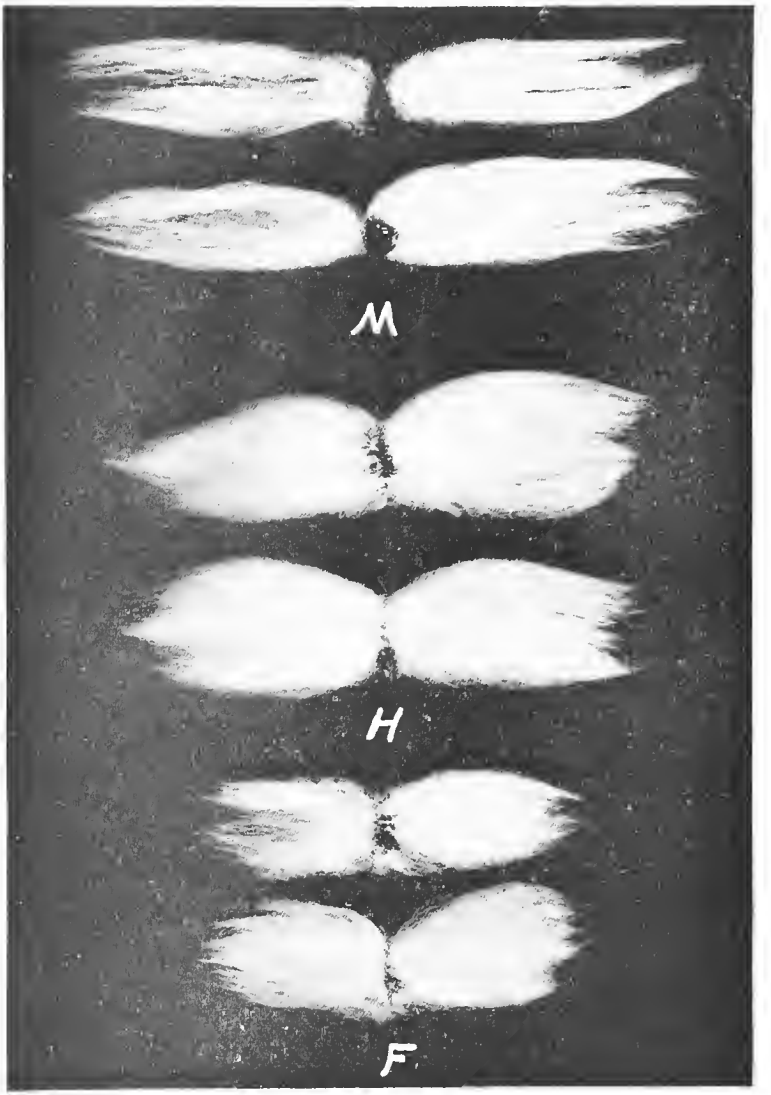

FIG. 3.

Seeds of hybrid cotton and its parents, with the fibre pulled out to show the relative lengths and amounts: M, Fibre of Sea Island Cotton, male parent; F, Fibre of Upland Cotton, female parent; H, Hybrid between them. (10-11 natural size.)

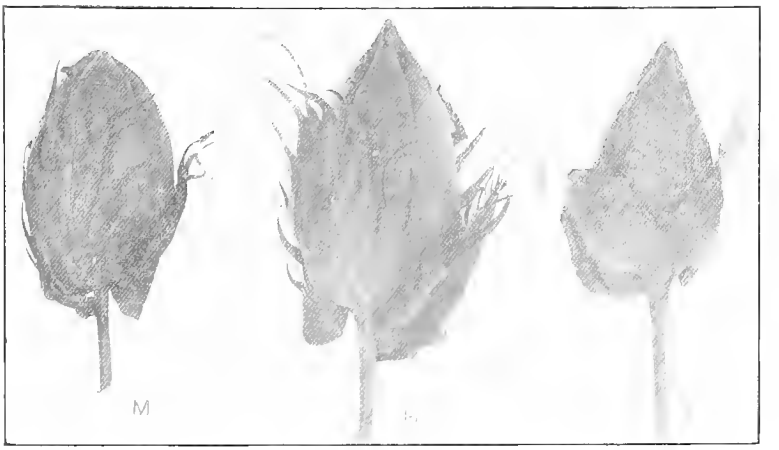

FIG. 4.

Bolls of Hybrid Cotton and its Parents: M, boll of Klondike (a variety of Upland Cotton), male parent; F, boll of Sea Island, female parent; H, boll of hybrid between them, showing increased size. (5-7 natural size.)

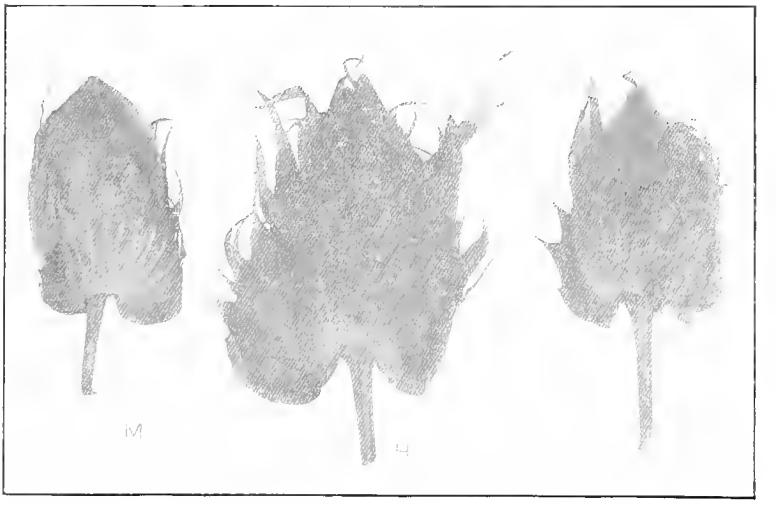

FIG. 5.

Bolls of Hybrid Cotton and of its Parents: M, boll of Klondike (a variety of Upland Cotton), male parent; F, boll of Ashmouni (a variety of Egyptian Cotton), female parent; H, boll of hybrid between them, showing increased size. (5-7 natural size.)

Mr. THOMAS H. SMITH. What is the name of this fungus that you speak of?

Mr. H. J. WEBBER. It is a Fusarium. It belongs to a new class of diseases that was discovered only a few years ago by Dr. E. F. SMITH of the Department. It enters the roots and penetrates up into the stem, causing a blackening of the wood of the stem.

Mr. THOMAS H. SMITH. Has it spread over the cotton district to any extent?

Mr. H. J. WEBBER. It has spread all over the Sea Island district, but in the upland district it occurs, so far as I know, only in Carolina and Georgia. It is not very general in upland regions. There are a few other diseases; one called the root-rot (Ozonium), occurs in Texas and Louisiana. We have not done any special work with this malady but probably resistant strains can be selected here as in the case of the wilt.

I notice two other photographs here that I did not pass around, showing the increased size of the bolls. You can see them from where you are sitting. This is the upland and this is the Sea Island, and here are the bolls of hybrids, and here are the bolls of another hybrid. You can very readily see the increased size of the bolls of the hybrid.

Mr. WILLIAM G. NICHOLS. Have you given any special attention to the matter of uniformity?

Mr. H. J. WEBBER. Yes, and we find that the hybrids vary greatly in uniformity. Frequently the fibres at the point of the seed will be short, while those at the apex of the seed are quite long. But this, of course, may be corrected by selection. And in all the selection practiced by the Sea Island growers, uniformity is one of the most important factors that is taken into consideration. They give the greatest attention to this, not only pronouncing on it themselves, but usually sending

the samples to an expert factor and getting his opinion in regard to the market value of the individual samples, so that great care is exercised in all factors of this nature.

Mr. BROADUS E. WILLINGHAM. Will you please tell us as to the coarseness of the fibre — is it coarse or fine?

Mr. H. J. WEBBER. The fibre is about intermediate between Sea Island and upland. It is very much finer than the upland and has the silkiness of the Sea Island. If you twist the fibres into a mat they are silky and have all the appearance of Sea Island. A similar type which has been put in the mills of South Carolina, can be detected, it is said, the moment it enters the manufacture, from the smoothness. I do not know why it is, because I am not familiar with the manufacturing side, but it is said that the machinery responds to it much better and that the difference is easily recognized. The fibre is also much stronger on an average than the fibre of the upland.

Mr. J. R. MONTGOMERY. In your experiments with the Egyptian cotton, do you preserve the color and the characteristics of the Egyptian fibre?

Mr. H. J. WEBBER. Well, so far as the hybrids are concerned, they do not; but the pure Egyptian, when brought over here and grown, do seem to preserve the quality and color of fibre to some extent. In one of the cases that is passed around you will see a sample of the imported fibre of Egyptian, which I take to be the variety Mit-Afifi, in comparison with the same variety which was imported into Texas five years ago and grown there for very nearly five years, and then grown by us in our experimental plats in South Carolina last year. So far as I can tell from examination of those samples, they seem to have the typical crinkly, curly appearance of the Egyptian cotton, also the tawny brown color. On the contrary, the Ashmouni variety when grown in this country usually loses that tawny character and becomes quite white.

Mr. WILLIAM G. NICHOLS. I think it is a very strong strain.

Mr. H. J. WEBBER. One of the questions we desire very much to know in experimenting on cottons is in regard to the intensity of this color that you as manufacturers desire. Do you want a light brown color, do you prefer a white, do you want a dark brown, or do you want all colors?

Mr. WALTER E. PARKER. We want all of them.

Mr. H. J. WEBBER. Is it a decided advantage to have a deep brown color?

Mr. WALTER E. PARKER. It is in some instances.

Mr. H. J. WEBBER. Well, we can produce the dark brown color without question, because the Peruvian is a very dark brown, but it is coarse; it will have to be improved by infusing Sea Island and strains of that nature.

Mr. C. M. SEARS. How can the average farmer secure the seeds if this is such a slow process?

Mr. H. J. WEBBER. As soon as the hybrids have been tested so that we know they are stable varieties, there will be some means found of producing them so that they will be put in the hands of growers. But at the present time they have only been growing one or two years, and it requires from five to six years to perfect them. You see after getting the hybrid it is absolutely necessary to fix it and render it stable, because hybrids are notoriously variable; so it will require from five to six years longer to fix the strains we have already secured. That is not the case in selected strains of Sea Island because they are already bred up to the length of fibre, and it simply remains for us to prove that we have a resistant strain, and then to produce seed of it in sufficient abundance to send out. Even this, however, requires time.

Mr. WILLIAM G. NICHOLS. What is the cause of that tawny color?

Mr. H. J. WEBBER. It is evidently due to hybridization in the past history of the plant with a brown cotton. In Peru and other places, you know there are cottons which are perfectly brown; and we are now making tests in hybridizing the brown Peruvian cotton with the Sea Island and upland varieties in order to get this color. The color varies in Peruvian cottons all the way from a light brown to a deep brown; and it is supposed, I don't know how truthfully, that the color in this Egyptian cotton comes from a strain of one of the brown South American cottons infused into Sea Island.

Mr. THOMAS H. SMITH. It is not the mud from the Nile that causes it?

Mr. H. J. WEBBER. I don't understand you.

Mr. THOMAS H. SMITH. It is not the mud from the Nile that causes it?

Mr. H. J. WEBBER. Oh! Possibly it is due to the mud from the Nile. We will possibly have to produce that mud over here.

Mr. WILLIAM G. NICHOLS. Is the Canary cotton that is produced to a very limited extent in this country simply a strain, or is it some variety produced by hybridization?

Mr. H. J. WEBBER. I cannot tell in regard to that; I am not familiar with the variety. Is it grown under the name of Canary cotton generally?

Mr. WILLIAM G. NICHOLS. I think that is the name in the market. There is only a very small amount produced.

Mr. H. J. WEBBER. I could not inform you in regard to it; I am not familiar with the variety.

Mr. C. M. SEARS. In the case of the wilt, if the production of a strain which will resist this fungus will take as long and require such an enormous quantity of seed, I should think by the time that the healthy seed got to the farmer, he would not have any cotton alive, if it took five or six years to produce the seed.

Mr. H. J. WEBBER. That is an important point. We must not attempt to produce all the seed for the farmer. We must put the information in the hands of the farmer so that he can select the seed and produce the resistant strain for himself. It is perfectly possible for the farmers to do this, and we shall simply put the knowledge in their hands which will enable them to do so. Of course you understand that if we have one plant which produces resistant seed, it will only produce 500 plants the first year, which will give enough seed for five acres the second year, and a general crop the following year. It will thus require a considerable period of time to secure sufficient seed of any desirable strain for a general distribution.